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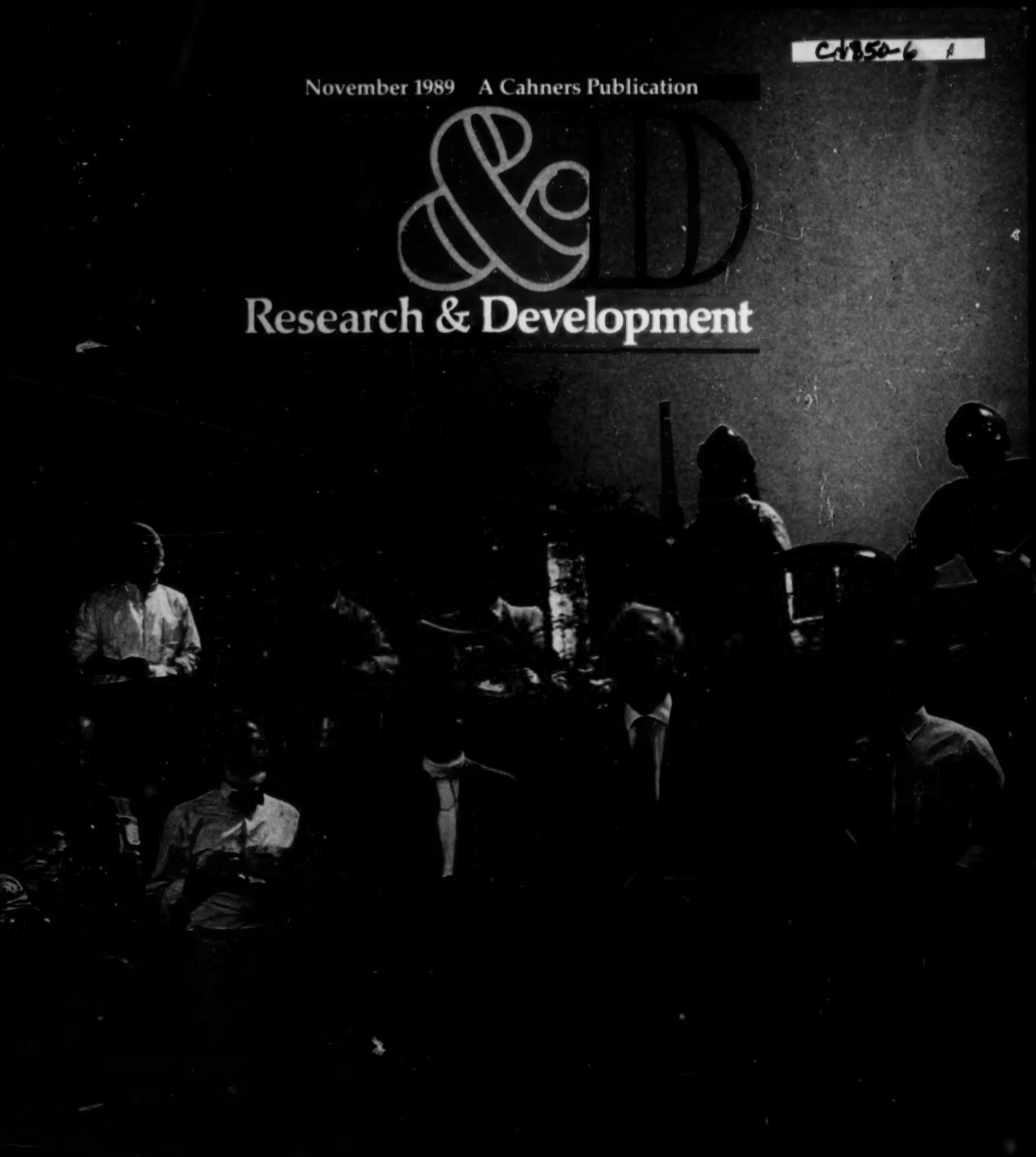

How they built Thermo Electron into 'a perpetual idea machine'

COMPUTERS

Molecular dynamics on a desktop

SPECIAL REPORT

DARPA: Gambling on high-risk R&D

INTERNATIONAL JOURNAL OF RESEARCH, DEVELOPMENT, AND QUALITY ASSURANCE

R&D

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ON THE COVER
George Hatsopoulos (front row, red tie), CEO of Thermo Electron Corp., *R&D* magazine's first Corporation of the Year, is shown with company employes. That's a 150-ton gas-engine-driven cogenerating air conditioner, one of the company's products. *Photo by Christopher Morrow.*

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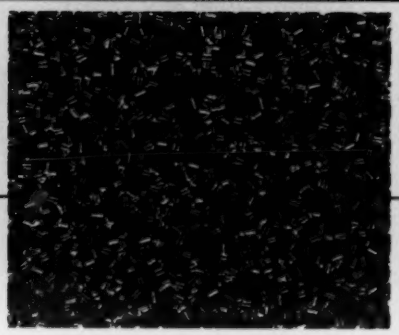

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Biotech firms need more money for R&D

RESEARCH-BASED companies continue to deploy resources to biotechnology, but money is not available to do everything," says Irwin M. Lerner, president and CEO of Hoffman-La Roche, a multinational pharmaceutical company.

Lerner's comments are part of a biotech industrial survey that cites limited R&D funding, expensive capital, and complex regulations as the most crucial issues facing U.S. biotech companies.

Across all emerging technologies, seed capital in privately held companies is down 30% to 50% from two years ago. Second- and third-round financing is even harder to obtain.

For companies that overcome the financial hurdles, future prospects are bright. Over the next five years, the U.S. biotechnology industry expects a 1,000% increase in sales, a tripling of marketing and manufacturing personnel, and a 50% increase in R&D personnel, according to the survey.

Most biotech companies are currently negotiating strategic alliances with firms in foreign markets. An even larger proportion are negotiating alliances for the U.S. market.

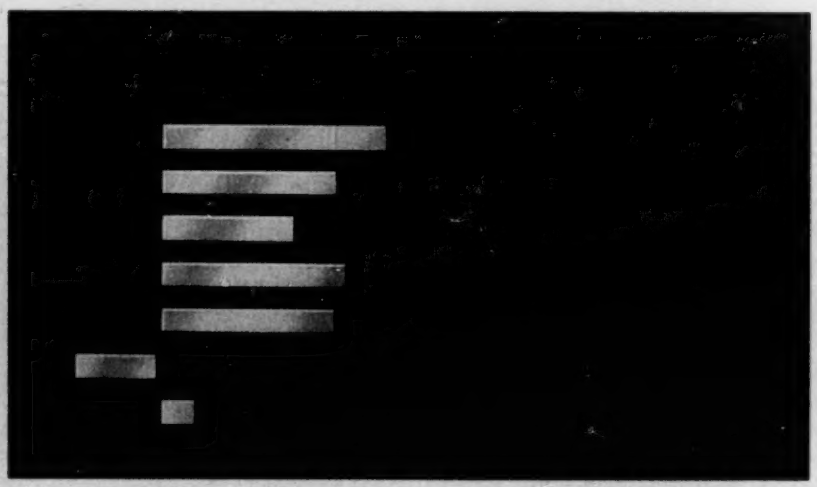
The short-term development bias in the U.S. may force some biotech companies to join U.S. pharmaceutical firms or Japanese companies with the backing to support short-term realities and long-term plans.

"The U.S. will be partners and competitors with Japan in biotechnology," says Lerner. "Japan has reached the point where licensing is no longer their best strategic option."

Japan is expected to be a major player in biotechnology in the 1990s. The Japanese government is actively supporting its Human Frontier basic science project with a budget of $17 billion.

"The U.S. remains the world leader in biotechnology and can continue [to be the leader] provided the climate remains supportive," says Lerner.

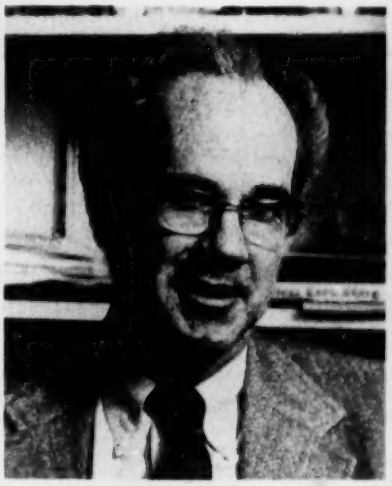
The survey, "Biotech 90: Into the Next Decade," was conducted by Ernst & Young, 1 Sansome St., Suite 3500, San Francisco, CA 94104. Cost: $80. —*Tim Studt*



Most biotech indicators increased from last year; but asset growth was outpaced because not enough financing was available to keep pace with the sector's growth.

Harvard's Walton: U.S. technology underused

THE U.S. is not using technology effectively, Japan is," says Harvard Business School's Richard Walton in his recently published book on information technologies (IT).



***Richard Walton:** New technology must include organizational changes.*

Walton, the Jesse Isidor Straus professor of business administration, cites a Harvard study that compares 95 flexible manufacturing systems in Japan and the U.S. This study reveals that the average number of parts produced on U.S. systems is 10, while the number on Japanese systems is 93.

These differences are attributed to the degree of computer control in the system, the technical skill of the work force, and management approaches.

Walton details the experiences of 19 organizations that "struggled" to integrate new information systems into their companies.

"Advanced technology by itself is unable to guarantee the advantages regularly delivered by technology accompanied by work reorganization," says Walton.

Up and Running: Integrating Information Technology and the Organization is available from Harvard Business School Press, Soldiers Field, Boston, MA. 617/495-6700. □

Get your patents on the fast track

A PROCEDURE that can reduce the time required to process a new patent application is available but not widely known, according to Stephen Glazier, a New York-based patent attorney.

"Within the patent office, there's a

fast track and a slow track, and unless you request otherwise, you get put on the slow track," says Glazier.

To get on the fast track, an inventor must petition for and be granted an accelerated examination. This process moves the application to the front of the line, but limits the interaction between the applicant and the examiner to one amendment cycle.

The accelerated process can work well when the application is for a simple device or process and not complicated by closely related technologies.

A petition for an accelerated examination must be customized for each application and include the results and analysis of a patent search.

Although legal costs for this process can be higher, getting a patent faster can be important in obtaining venture capital and bringing a product to market. "If you have a person with a checkbook waiting to give you money, it's worth a few thousand dollars to get rid of a two-year wait," Glazier says.

While inventors can apply for acceleration with any patent application, the patent law favors accelerating inventions relating to environmental quality, energy conservation, safe research of DNA, and superconductivity. An inventor's poor health or advanced age, manufacture contingent upon a patent, and infringement also can accelerate a patent application.

"It's not a procedure for all applications," Glazier says. "You have to sit down with your patent attorney and look at the individual case."

—Elizabeth Dougherty

Top 10 Japanese spenders on R&D

		1988 spending*
1	Fujitsu	$1,690
2	NEC	1,450
3	Hitachi	1,430
4	Toshiba	980
5	Nippon Teleg./Tel.	850
6	Mitsubishi Elec.	600
7	Canon	530
8	Tokyo Elec. Power	420
9	Fuji Photo Film	380
10	Mitsubishi Motor	330

*Millions of U.S. dollars

High tech leads R&D spending in Japan

HIGHLY DIVERSIFIED electronics firms head the list of Japan's biggest R&D spenders, says Nihon Keizai Shimbun, a Tokyo-based publishing firm.

The top spender, Fujitsu, spends most of its $1.7 billion R&D budget on computer and semiconductor research. For computer research, the focus is on supercomputers, artificial intelligence, and machine translation. Semiconductor research concentrates on 4- and 16-Mbit DRAM devices.

The R&D costs are defined as those allocated to sales management expenses in the profit and loss account and do not include those apportioned to production costs. If those production R&D costs are included, Hitachi's R&D spending is more than $2.3 billion. □

Big Blue's big bang will be coming soon

MORE THAN two thirds of IBM's R&D expenditures over the past six years, or $13 billion, has yet to be associated with any notable products, according to International Technology Group (ITG), a Los Altos, CA, consulting firm.

ITG predicts that this money has been spent to develop a whole new line of mainframes, midrange computer systems, workstations, and communication systems that IBM plans to introduce in 1991 or 1992. This "big bang" will culminate a long-term research plan that will reinforce IBM's position for those customers with large computer systems.

"IBM has made some short-term mistakes. They also have lost market share to companies like Amdahl due to their long-term planning," says Brian Jeffrey, managing director of ITG.

By the early 1990s, however, he predicts IBM will pull ahead in computer architecture, data communications, and basic components and materials.

Part of IBM's strategy, ITG contends, is that most current IBM equipment will be compatible with the new equipment and will be upgradable with simple board exchanges.

Mainframe replacements

At the top of the line, IBM's current 32-bit mainframe (Model 3090) will be replaced by a 48-bit hybrid system, called Summit, that implements a preliminary form of parallel processing. The new mainframe will use limited instruction set computing (LISC) hardware and reduced instruction set computing (RISC) input-output process architecture.

Summit also will have supercomputer capabilities. IBM and Steve Chen, formerly of Cray Research, have been working on a parallel processing system that also is expected to be introduced in the 1991 time frame. ITG expects this system to be a functional process module that can be added to the Summit mainframe. Its performance is expected to be between that of a minisuper and a Cray-type supercomputer, but it will still have the multifunctional capabilities typical of a mainframe.

ITG also predicts a second round of new IBM product introductions to occur about 1996. Until then, IBM has been acquiring software companies as a holding action and to increase acceptance of its current products. □

Do you live in an R&D hotbed?

NEW YORK, MICHIGAN, and California were the top three states for the construction of new R&D centers in 1988, according to the Industrial Development Research Council, an Atlanta-based association of real estate executives.

The top five cities with new R&D centers last year were Ann Arbor (9), Detroit (8), Raleigh-Durham (7), and Atlanta, San Francisco/Oakland, and Syracuse (6 each). There were 266 new R&D facilities started in 1988, an 8% increase, bringing the U.S. total to 3,570. Washington, DC (190), Boston (148), and Detroit (95) continued their leadership in the number of centers. The listing includes all new and existing corporate, government, university, and nonprofit facilities.

State	New centers in 1988	Total R&D centers
California	22	315
Massachusetts	1	194
Michigan	28	191
Pennsylvania	16	188
New York	29	139
Maryland	1	134
Florida	15	124
Texas	9	109
Illinois	4	106
Ohio	7	98

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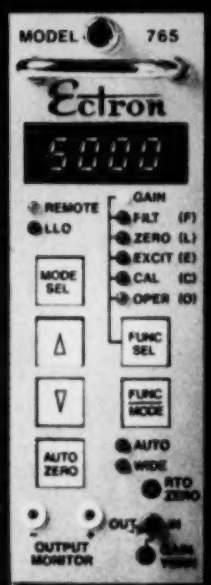

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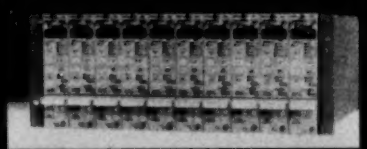

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